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Effect of Spirulina on Arsenicosis Patients in Bangladesh

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Abstract

A double-blind randomized clinical trial was carried out among Arsenicosis patients of Sonargaon thana of Narayanganj district, to see the effect of Spirulina on Arsenicosis disease resulting from drinking arsenic contaminated ground water through hand pump tubewells in many parts of Bangladesh. Spirulina is a microscopic blue green algae, used as a food supplement but it has some therapeutic value in treating some ailments. It is rich in protein, amino acid, beta-carotene, vitamins etc. 50 arsenicosis patients has been identified through simple random sampling from 185 arsenicosis patients of three villages, who had been diagnosed as cases of arsenicosis by the physicians, depending on the presence of visible signs. The patients included male and female of different age. A double blind method was followed during the drug distribution. It was found after distribution that 33 patient got Spirulina and 17 patient got placebo. 3 gm Spirulina per day per person and same dose of placebo was used as drugs for three-month duration and consumption of arsenic free safe water was ensured for both the group (Spirulina and placebo) during the total duration of study. Physical examinations of these patients were done carefully at every fifteen days interval during the intervention using a structured checklist.

After three month it was found that 27 (81.81%) patient showed evidence of improvement by diminishing the visible manifestation among 33 patients who got Spirulina. Statistical analysis showed significant correlation between Spirulina intake and diminishing of visible skin manifestation of chronic arsenicosis ($P<0.001$).

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Introduction

Bangladesh has been suffering from serious public health problem arising from drinking arsenic contaminated groundwater source. Nearly 62 out of total 64 districts of the country are recently reported of the presence of dangerous levels of inorganic arsenic in most of the tubewells, which are currently serving as water points mainly for drinking and cooking purpose. People who are drinking this inorganic arsenic contaminated water develops various pathological manifestation in the their bodies. The time to develop symptoms from drinking arsenic contaminated water varies by duration of drinking contaminated water and concentration of inorganic arsenic in the water. Manifestations are found irrespective of gender and ages. Early manifestation within 6 months is not uncommon. Manifestation starts from hyper pigmentation of skin and mucous membrane and leads to death from mutation of tissues in the body[1].

The arsenic poisoning from the contamination of underground water is chronic in nature. Most of the time the victims do not complain of the above symptoms until they are detected through screening survey. The above symptoms are also very difficult to identify from other clinical conditions. The present experience to identify the arsenic cases are by external manifestations, specially with the presentation on the skin called melanosis, leucomelanosis and hyperkeratosis with the history of consuming arsenic contaminated source water.

Clinical study suggests that algae having a very high concentration of micronutrients and vitamins may have good effects on people suffering from heavy metal poisoning. Spirulina, a microscopic blue-green algae, has a property of reducing heavy metals and nephrotoxic substance from the body. Spiru1ina is not only a whole food, but it seems to be an ideal therapeutic supplement. So far no other natural food is found with such a combination and amazing

concentration of so many unusual nutrients like protein amino acid, iron, beta-carotene, phycocyanin, gama lenolenic acid, vitamin B1, B2, B3, B6, B12, essential fatty acid etc. In fact it is the highest known source of protein, beta-carotene which is a precursor of vitamin A and only vegetable source of vitamin B 12[2]. Beta-carotene concentration of Spirulina is ten times higher than carrot. It was evident that food rich in beta-carotene can reduce the risk of cancer. It was found in the laboratory that the natural carotene of Spirulina could inhibit, shrink and destroy oral cancer cells. Phycocyanin of Spirulina also prevents cancer and its growth. Over 100 animal studies have confirmed Vitamin A and beta-carotene inhibit the development of cancers and tumors. Many human epidemiological studies correlated high Vitamin A intake with decreased cancer risks[3]. Additional work showed beta-carotene correlated with lower cancer rates[4]. Clinical study also suggests that Spirulina may have a beneficial effect on people suffering from heavy metal poisoning.

In 1987 an Israeli study demonstrated natural beta-carotene is more effective than the synthetic form. The human body better assimilates natural beta-carotene because it contains the 9-cis carotenoid isomer, which is lacking in synthetic carotene molecules. This means beta-carotene in algae and leafy green vegetables has greater anti-oxidant effects than synthetic beta-carotene[5].

Inorganic arsenic is a known carcinogen and affect human cells by producing damaging free radicals and an antioxidants cut the level of free radical in the arsenic exposed cells by half. Vitamin A, C and E are known antioxidants that play some role in healing excoriation of epidermis of the skin. Although very high dosages of Vitamin A supplements are toxic. But high amounts of natural beta-carotene which is the precursor of vitamin A is safe. Spirulina is the richest source of beta-carotene than any other food, including carrots.

Due to rich in natural content of antioxidant and high protein content many studies showed its effectiveness in alleviating several disease condition. As Spirulina has a property of reducing heavy metals and nephrotoxic substance

from the body the present study was designed to see whether it could leave an evidence of beneficial effect in treating the patients suffering from arsenicosis.

Materials and Methods

This experimental study was conducted among the Arsenicosis patients of three-selected village of Sonargaon thana of Narayanganj district, where hand pump tube well were known to be contaminated by arsenic. The duration of this study was for three months. 50 arsenicosis patients has been identified through simple random sampling from 185 arsenicosis patients of three villages, who has been diagnosed as case of arsenicosis, depending on the presence of visible skin manifestation through careful clinical examination by trained physicians. All these cases were re-examined by experts.

A double blind method was followed during the drug allocation by an assistant, who did not know about the content of the container. The placebo and Spirulina was dispensed in capsule form with similar size, color and in container with similar labeling. It was found after distribution that 33 patient got Spirulina and 17 patient got placebo. 3 gm Spirulina per day per person and same dose of placebo was used as drugs for three-month duration and arsenic free safe water was ensured for both the group (Spirulina and placebo) for the total duration of study. Physical examination of these patients were done carefully before and after intervention.

Patients were found at different stages of arsenicosis. The stages were operationalized clinically for this study purpose as follows:

Stage I: It includes melanosis, keratosis, and conjunctivitis.

Stage II: It includes leucomelanosis, hyperkeratosis.

Stage III: It includes hyperkeratosis with nodule (wart like lesion) in palm and sole, non-pitting edema.

A check-list consisting indicators of various aspects regarding duration of contaminated water consumption, history of disease occurrence and clinical findings was used as instrument for data collection. Physical examination of

these patients was done carefully for visible signs of arsenicosis and photograph has been taken to compare the condition before and after intervention.

Data has been collected at every fifteen days interval by examining the patients with the help of a checklist to see the effectiveness of Spirulina.

Data has been analyzed after thorough clearing and compiling through frequency table and cross tables and data matrix. Statistical software has been used for analysis and interpretation has been done accordingly.

Result

Characteristic of the study group:

Age and sex: The patients were male and female of different age. Among the study group the Spirulina and placebo was distributed at random blindly. A double blind method was followed where neither the patient nor the drug distributor knew who is getting what. Subsequently it appeared after checking by the investigator that thirty-three patients got Spirulina and seventeen patients got placebo. Eighteen male and fifteen female patients had received Spirulina. Out of seventeen patients who received placebo, thirteen were male and four were female.

The age and sex distribution of the patient who got Spirulina and placebo is shown in table 4.

Table :4

Age group	Spirulina		Placebo		Total
	male	female	male	female	
<15 years	0	1	0	1	2
15-30 years	8	7	6	1	22
22 >30 years	10	7	7	2	26
Total	18	15	13	4	50

The patients were followed every fifteen days interval to see the effect of Spirulina. After three months it was found that 27 (81.81%) patient showed improvement among the thirty-three patients who got Spirulina and the condition of (18.18%) patient remain unchanged. Two patients showed the signs of improvement among the fifteen patients who received placebo. Statistical analysis shows significant correlation between Spirulina intake and diminishing of visible skin manifestation of Arsenicosis patients.

Table: 5

State	Placebo	Spirulina	Total
Improved	2	27	29
Not improved	15	6	21
Total	17	33	50

Chi-square Test : 22.61 Df : 1 $p < 0.001$

Table: 6 showing the state of clinical symptom and the impact of Spirulina.

Improvement	**Stage** -?	**Stage** -??	**Stage** -???	**Total**
Total improvement	5 (15%)	5 (15%)	0	10 (30.30%)
Partial improvement	3 (9.09%)	9 (27.27%)	5 (15.15%)	17 (51.51%)
Unchanged	0	1 (3.03%)	5 (15.15%)	6 (18.18%)
Total	8 (24.09%)	15 (45.3%)	10 (30.30%)	33 (100%)

It has been observed from the study that female improved more than male. Table 7 showing the relationship of age & sex with the state of improvement in the patient who received Spirulina (observation after three months with the 3 gram Spirulina daily).

Table 7: showing the relationship of age & sex with the state of improvement among the patients

Age group	**Male**			**Female**		
	Total improvement	Partial improvement	Unchanged	Total Improvement	Partial Improvement	Unchanged
<15 years	0	0	0	0	1	0
15 – 30 years	2	4	2	4	2	1
> 30 years	0	7	3	4	3	0
Total	2	11	5	8	6	1

Discussion

Spirulina is a simple, one-celled form of algae that thrives in warm, alkaline fresh water bodies. It is one of the blue-green algae due to the presence of both chlorophyll (green) and phycocyanin (blue) pigments in its cellular structure. In fact it is the highest known source of protein, beta-carotene and only vegetable source of vitamin B 12. Roughly it contains 55%--70% proteins, 15%--25% carbohydrates and 5% fat.

This study was undertaken to see the effect of Spirulina and to observe the compliance behavior of the patient about the acceptance of this diet supplement as a drug. The exception of this study was also in the presentation of the Spirulina in the capsule form, as some patient found it unpleasant by taste and odor in uncoated Spirulina. This study showed that 27 patient (81.81 %) improved after having 3 gm Spirulina for three month. 5 patient (15%) who were in stage I and 5 patient (15%) who were in stage II showed total improvement. 3 patient of stage I, 9 patient of stage II and 5 patient of stage III showed partial improvement.

A hospital based, prospective, non-randomized clinical trial with Spirulina on arsenicosis patients in Bangladesh also demonstrate improvement in reducing skin manifestation of patient of arsenicosis who received 10 gm Spirulina daily for four months[6].

Conclusion

A research conducted in Japan has shown that Spirulina reduced nephrotoxicity from mercury and three pharmaceutical drugs in laboratory rats[7]. With the clinical use of Spirulina in hospitals or for outpatients, higher dosage of such drugs and shorter recovery times may be possible. This study also leaves the significant evidence in reducing the clinical manifestation of inorganic arsenic toxicity in human body. Although mechanism of reducing the manifestation and mode of action of Spirulina in human body was not attempted. But further investigation in this line may make more clear evidence to use Spirulina as a fingertip treatment for arsenicosis.

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